COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/if not in response to a program announcement/solicitation enter NSF 02-2

NSF 00-78 **02/19/02**

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)

DGE - IGERT FULL PROPOSALS

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NSF PROPOSAL NUMBER

0221041

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
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EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)

135598093

SHOW PREVIOUS AWARD NO. IF THIS IS
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IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE

Columbia University

AWARDEE ORGANIZATION CODE (IF KNOWN)

0027078000

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE

Columbia University
1210 Amsterdam Avenue; MC 2205
New York, NY. 10027

NAME OF PERFORMING ORGANIZATION, IF DIFFERENT FROM ABOVE

PERFORMING ORGANIZATION CODE (IF KNOWN)

ADDRESS OF PERFORMING ORGANIZATION, IF DIFFERENT, INCLUDING 9 DIGIT ZIP CODE

IS AWARDEE ORGANIZATION (Check All That Apply)
(See GPG II.C For Definitions) ☐ FOR-PROFIT ORGANIZATION ☐ SMALL BUSINESS ☐ MINORITY BUSINESS ☐ WOMAN-OWNED BUSINESS

TITLE OF PROPOSED PROJECT **A Joint Graduate Program in Applied Mathematics and the Earth & Environmental Sciences**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PREPROPOSAL NO., IF APPLICABLE
$ **2,691,846**	**60** months	**07/01/02**	**0130050**

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR (GPG I.A)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG I.B, II.C.6)
☐ HISTORIC PLACES (GPG II.C.9)
☐ SMALL GRANT FOR EXPLOR. RESEARCH (SGER) (GPG II.C.11)
☐ VERTEBRATE ANIMALS (GPG II.C.11) IACUC App. Date _____
☐ HUMAN SUBJECTS (GPG II.C.11)
Exemption Subsection _____ or IRB App. Date _____
☐ INTERNATIONAL COOPERATIVE ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.9)
_____
☐ HIGH RESOLUTION GRAPHICS/OTHER GRAPHICS WHERE EXACT COLOR REPRESENTATION IS REQUIRED FOR PROPER INTERPRETATION (GPG I.E.1)

PI/PD DEPARTMENT
Applied Physics & Applied Mathematics

PI/PD FAX NUMBER
212-865-8257

PI/PD POSTAL ADDRESS
S.W. Mudd, Room 216
500 West 120th Street
New York, NY 10027
United States

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Electronic Mail Address
PI/PD NAME **Lorenzo M Polvani**	**PhD**	**1988**	**212-854-7331**	**polvani@columbia.edu**
CO-PI/PD **Victor H De la Pena**	**PhD**	**1988**	**212-854-5360**	**vp@stat.columbia.edu**
CO-PI/PD **Upmanu Lall**	**PhD**	**1981**	**212-854-8905**	**ula2@columbia.edu**
CO-PI/PD **Duong H Phong**	**PhD**	**1977**	**212-854-4112**	**phong@math.columbia.edu**
CO-PI/PD **Martin Visbeck**	**PhD**	**1993**	**845-365-8531**	**visbeck@ldeo.columbia.edu**

Electronic Signature

CERTIFICATION PAGE

Certification for Authorized Organizational Representative or Individual Applicant:

By signing and submitting this proposal, the individual applicant or the authorized official of the applicant institution is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding debarment and suspension, drug-free workplace, and lobbying activities (see below), as set forth in Grant Proposal Guide (GPG), NSF 02-2. Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U. S. Code, Title 18, Section 1001).

In addition, if the applicant institution employs more than fifty persons, the authorized official of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of Grant Policy Manual Section 510; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution's expenditure of any funds under the award, in accordance with the institution's conflict of interest policy. Conflicts which cannot be satisfactorily managed, reduced or eliminated must be disclosed to NSF.

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By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Drug Free Work Place Certification contained in Appendix A of the Grant Proposal Guide.

Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes ☐ No ☒

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Debarment and Suspension Certification contained in Appendix B of the Grant Proposal Guide.

Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, ''Disclosure of Lobbying Activities,'' in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME **Veronica Murray**	**Electronic Signature**	**Feb 14 2002 5:00PM**

TELEPHONE NUMBER	ELECTRONIC MAIL ADDRESS	FAX NUMBER
212-854-6851	**vm34@columbia.edu**	**212-854-2738**

*SUBMISSION OF SOCIAL SECURITY NUMBERS IS VOLUNTARY AND WILL NOT AFFECT THE ORGANIZATION'S ELIGIBILITY FOR AN AWARD. HOWEVER, THEY ARE AN INTEGRAL PART OF THE INFORMATION SYSTEM AND ASSIST IN PROCESSING THE PROPOSAL. SSN SOLICITED UNDER NSF ACT OF 1950, AS AMENDED.

PROPOSAL NO.: 0221041
PRINCIPAL INVESTIGATOR: Polvani, Lorenzo
INSTITUTION NAME: Columbia University
TITLE: IGERT: A Joint Graduate Program in Applied Mathematics and the Earth & Environmental Sciences
NSF RECEIVED DATE: 02/14/2002

A Joint Graduate Program in Applied Mathematics and the Earth & Environmental Sciences

Lorenzo M. Polvani – Columbia University

Columbia University proposes to establish a new, multi-departmental graduate program in Applied Mathematics and the Earth & Environmental Sciences. The aim of this new IGERT Joint Program is to train a new generation of scientists whose level of mathematical sophistication will be considerably higher than that of typical students currently graduating from earth and environmental science programs and, at the same time, whose familiarity with the important issues and major open research questions in the earth and environmental sciences will be much deeper that what is usually expected of students trained uniquely within applied mathematics departments.

In order to achieve this goal, five departments at Columbia – Mathematics, Statistics, Applied Physics & Applied Mathematics, Earth & Environmental Sciences, and Earth & Environmental Engineering – under the coordinating role of the Columbia Earth Institute, will collaboratively train graduate students under this new IGERT Joint Program.

While students in the IGERT Joint Program will be individually admitted by each department, their progress will be monitored by a Steering Committee of faculty associated with the Joint Program. In addition to satisfying the requirements of the departments into which they are admitted, all students in the Joint Program will take a new integrated two-semester sequence in Applied Mathematics specifically tailored to issues and problems in the global environmental sciences, and will be expected to earn a minimum number of credits in both mathematical and earth science courses. In addition, they will be expected to attend a weekly colloquium organized by the Joint Program, give a formal presentation of their research results once a year to the faculty and other students affiliated with the Joint Program, attend special series of invited lectures, assist in the mentoring of undergraduates, and complete a one summer internship during their graduate training at a research institution, national laboratory, or industrial research center.

PROPOSAL NO	INSTITUTION	PLEASE RETURN BY
0221041	Columbia University	09/24/03

PRINCIPAL INVESTIGATOR	NSF PROGRAM
Polvani, Lorenzo M.	IGERT FULL PROPOSALS

PROPOSAL TITLE
IGERT: A Joint Graduate Program in Applied Mathematics and the Earth & Environmental Sciences

	REVIEWER	NSF I.D GENDER DISCIPLINE PIN	DATE SENT RETURNED	REVIEWER (R) PANELIST (P) BOTH (B)	REVIEWED (R) NOT REVIEWED (N) COI (C) LATE (L)	REVIEWER RATING
1	Dr. Joan Alexander, CoRA Division NorthWest Research Associates, Inc. 3380 Mitchell Lane Boulder, CO 80301- alexand@colorado-research.com	ZY0809378 Female Other Sciences NEC ******	05/02/02 04/30/02	1	R	Excellent
2	Dr. Kavita Arora, Dept. of Developmental and Cell Biology University of California, Irvine BiosciencesII, #4150 Irvine, CA 92697-2300 karora@uci.edu	ZZ0758264 Female Life Science Biological ******	05/02/02	P	P	
3	Dr. Carol A. Auer, Department of Plant Science, U-163 University of Connecticut 1390 Storrs Road Storrs, CT 06269- Carol.Auer@uconn.edu	ZR0734116 Female Life Science Biological ******	05/02/02	P	P	
4	Dr. Carla Caceres, Department of Animal Biology University of Illinois 515 Morrill Hall 505 S. Goodwin Ave Urbana, IL 61801- caceres@life.uiuc.edu	XR0761247 Female Environmental Biology ******	05/02/02	P	P	
5	Dr. Paul C. Jennings, Civil Engineering & Applied Mechanics California Institute of Technology Mail Code 104-44 Pasadena, CA 91125- pcjenn@caltech.edu	000103908 Male Engineering-Civil ******	05/02/02	P	P	
6	Dr. William S. Kisaalita, Biological & Agricultural Engineering Driftwier Engineering Center University of Georgia Athens, GA 30602- williamk@bae.uga.edu	PM0742511 Male Engineering-Chemical ******	05/02/02	P	P	

PROPOSAL NO	INSTITUTION	PLEASE RETURN BY
0221041	Columbia University	09/24/03

PRINCIPAL INVESTIGATOR	NSF PROGRAM
Polvani, Lorenzo M.	IGERT FULL PROPOSALS

PROPOSAL TITLE
IGERT: A Joint Graduate Program in Applied Mathematics and the Earth & Environmental Sciences

	REVIEWER	NSF I.D GENDER DISCIPLINE PIN	DATE SENT RETURNED	REVIEWER (R) PANELIST (P) BOTH (B)	REVIEWED (R) NOT REVIEWED (N) COI (C) LATE (L)	REVIEWER RATING
7	Dr. Wendy E. Krause, Lynntech Inc. Suite 202 7610 Eastmark Drive College Station, TX 77840- wkrause@lynntech.com	PM0809362 Female Other Sciences NEC ******	05/02/02 05/03/02	B	R	R
8	Dr. Charles R. Lovell, Department of Biological Sciences University of South Carolina 715 Sumter Street Columbia, SC 29208- lovell@biol.sc.edu	RO0564165 Male Life Science Biological ******	05/02/02	P	P	
9	Dr. Richard L. Mayden, Department of Biology Saint Louis University 3507 Laclede Ave. St. Louis, MO 63103-2010 MAYDENRL@SLU.EDU	GN0562485 Male Life Science Biological ******	05/02/02	P	P	
10	Dr. Pedro Mendes, Virginia Bioinformatics Institute Virginia Polytechnic Institute and State 1880 Pratt Drive Blacksburg, VA 24061-0477 mendes@vt.edu	NE0801270 Male Life Sciences ******	05/02/02	P	P	
11	Dr. Ron Mittler, Department of Botany Iowa State University 353 Bessey Hall Ames, IA 50011- rmittler@iastate.edu	NG0797972 Male Other Sciences NEC ******	05/02/02	P	P	
12	Dr. Peter Nowak, Department of Rural Sociology University of Wisconsin 350 Agricultural Hall 1450 Linden Drive Madison, WI 53706- pnowak@facstaff.wisc.edu	EM0585991 Male Sociology ******	05/02/02	P	P	

PROPOSAL NO	INSTITUTION	PLEASE RETURN BY
0221041	Columbia University	09/24/03

PRINCIPAL INVESTIGATOR	NSF PROGRAM
Polvani, Lorenzo M.	IGERT FULL PROPOSALS

PROPOSAL TITLE

IGERT: A Joint Graduate Program in Applied Mathematics and the Earth & Environmental Sciences

	REVIEWER	NSF I.D GENDER DISCIPLINE PIN	DATE SENT RETURNED	REVIEWER (R) PANELIST (P) BOTH (B)	REVIEWED (R) NOT REVIEWED (N) COI (C) LATE (L)	REVIEWER RATING
13	Dr. Peggy O'Day, School of Natural Sciences University of California Merced PO Box 2039 Merced, CA 95344- poday@ucmerced.edu	KE0736450 Female Geological Sciences ******	05/02/02 04/29/02	B	R	Excellent
14	Dr. Ingrid Padilla, Dept. of Civil Engineering University of Puerto Rico Mayaguez PO Box 9041 Mayaguez, PR 00681- Ingrid@ce.uprm.edu	KX0809385 Female Physics ******	05/02/02	2	P	
15	Dr. Victor G. Rodgers, Dept. of Chemical & Biochemical Eng. The University of Iowa 4133 Seamens Center Iowa City, IA 52241- victor-rodgers@uiowa.edu	HK0702233 Male Engineering-Chemical ******	05/02/02	P	P	
16	Dr. Philip W. Rundel, Department of Biology University of California, Los Angeles Los Angeles, CA 90024-1786 rundel@biology.ucla.edu	KG0164590 Male Life Science Biological ******	05/02/02	P	P	
17	Dr. Clare Ryan, Management & Engr. Division University of Washington 123H Anderson, Box 352100 Seattle, WA 98105-6613 cmryan@u.washington.edu	HR0809361 Female Other Sciences NEC ******	05/02/02 04/26/02	B	R	Good
18	Dr. Eric S. Saltzman, Department of Earth System Science University of California-Irvine 220 Rowland Hall Irvine, CA 92697- esaltzma@uci.edu	TH0539068 Male Environmental Sciences ******	05/02/02	P	P	

PROPOSAL NO	INSTITUTION	PLEASE RETURN BY
0221041	Columbia University	09/24/03

PRINCIPAL INVESTIGATOR	NSF PROGRAM
Polvani, Lorenzo M.	IGERT FULL PROPOSALS

PROPOSAL TITLE
IGERT: A Joint Graduate Program in Applied Mathematics and the Earth & Environmental Sciences

	REVIEWER	NSF I.D GENDER DISCIPLINE PIN	DATE SENT RETURNED	REVIEWER (R) PANELIST (P) BOTH (B)	REVIEWED (R) NOT REVIEWED (N) COI (C) LATE (L)	REVIEWER RATING
19	Dr. Daniel L. Solomon, Coll. of Physical & Math. Sciences North Carolina State University Box 8201 Raleigh, NC 27695- solomon@stat.ncsu.edu	SH0620801 Male Mathematics ******	05/02/02	P	P	

PANEL: igert02fa
INSTITUTION: Columbia University
NSF PROGRAM: Integrative Graduate Education and Research Training Program, IGERT Full Proposals
PRINCIPAL INVESTIGATOR:
PROPOSAL TITLE: IGERT: A Joint Graduate Program in Applied Mathematics and the Earth & Environmental Sciences

PANEL SUMMARY:
Intellectual Merits:

Strengths-

This proposal is intellectually very strong. The proposed program seeks to train students to a high level of sophistication in mathematics with applications to research problems in the earth and environmental sciences. The proposed research is outstanding, very innovative and it integrates exceptionally qualified and experienced researchers and academic professionals.

The commitment of the Institution for long-term multidisciplinary education is obvious and very positive.

The inclusion of the Institute for Learning Technologies for the self-assessment of the program is a strong component of the proposed program.

Weakness-

Mathematical uncertainty should be addressed at some level. Mathematics could be an excellent tool to better understand earth and environmental systems, but there are limitations.

Broader Impacts:

Strengths-

The proposed activity properly addresses the need to integrate math and earth and environmental sciences.

The institution seems committed to the program as shown by their support of interdisciplinary faculty appointments: there are five faculty members already with joint appointment between the Applied Marthematics and Earth and Environmental Science.

Also the higher stipends committed by the institution enhances recruitment and retention of qualified students.

The career development opportunities for the students are very good.

Weakness-

There is a great need to address the problem of not recruiting a reasonable number of underrepresented groups in science and engineering. Although a sound plan is presented for the recruitment and retention of members from these groups, it is pointed out that the departments involved have not succeeded at this task in the past. This issue must be addressed by the proposers.

Some concerns were raised about the involvement of undergraduate students in the program.

The education and training component must be better defined in terms of courses that the students must take (better structure). For instance, it specifies that students must take 15 credits from the areas other than their field of specialization, but they dont define which courses. This gives too much leverage that may result in poor multidisciplinary education. They should have more specific guidelines on the interdisciplinary courses that will fullfill the students' requirements. Also, the concept of picking research problem was thought innovative, but unclear. A mechanism should be established to properly do this selection.

The educational plan could be more explicit in how the "interface" between disciplines is reached and experienced by students. Elements of leadership, teamwork, and career development were not specifically addressed in the proposal.

Summary:
This proposal has been highly recommended for funding.

PANEL RECOMMENDATION: Highly Recommended
PANEL RECOMMENDATION KEY:
HR:Highly Recommended, DNR:Do Not Recommend, R:Recommend

APPROVED BY: LOHMANN, CYNTHIA

Title:IGERT: A Joint Graduate Program in Applied Mathematics and the Earth & Environmental Sciences

Institution: Columbia University

NSF Program: Integrative Graduate Education and Research Training Program, IGERT Full Proposals

Principal Investigator: Polvani, Lorenzo M.

Received Date:04/30/02
Rating: Excellent

Review:

What is the intellectual merit of the proposed activity?

The proposed program seeks to train students to a high level of sophistication in mathematics with applications to research problems in the earth and environmental sciences. Such sophistication in mathematics is a necessity for studying many of the new and emerging problems in the earth and environmental sciences, particularly those problems in nonlinear dynamics that govern the motions in the earth's atmosphere, oceans, and interior. The proposed program would also demand students acquire a much greater familiarity with important issues in the earth and environmental sciences than is typical of applied mathematics departments.
The proposed IGERT program involves faculty in Math, Statistics, Applied Physics and Math, and Earth and Environmental Science and Engineering departments at Columbia University.

What are the broader impacts of the proposed activity?

Summary Statement

Recruitment of the best graduate students is arguably the fundamental key to success of any program like this. The best students today do not pursue graduate research in environmental sciences unless they are highly motivated by factors beyond simply landing a high paying job. One of the factors that motivates good students in choosing a graduate program may be the perceived relevance
or importance of the research to scientific, social, or environmental concerns. The best students are also often attracted to instutions and researchers with the best reputations, because association with such an institution or researcher can be an important factor in the

success of their own future careers.

The proposed program excels in all of these areas, and would likely be successful in its goals. The samples of research described include development of new systems of equations for atmospheric science applications, computational methods for magma dynamics, and statistical methods for treating mesoscale waves in global models. The proposed program would draw upon students and faculty in five separate departments, but at a single university. The proximity and ease with which interdisciplinary interactions can take place is a positive factor in the likelihood of the program's success.

Reviewer:

Alexander, Joan
CoRA Division

Email:alexand@colorado-research.com

Suggested Reviewers:

None

Conflict of Interest:

None

Title:IGERT: A Joint Graduate Program in Applied Mathematics and the Earth & Environmental Sciences

Institution: Columbia University

NSF Program: Integrative Graduate Education and Research Training Program, IGERT Full Proposals

Principal Investigator: Polvani, Lorenzo M.

Received Date:05/03/02
Rating:

Review:

What is the intellectual merit of the proposed activity?

The applicants propose to establish a new, multi-departmental graduate program in Applied Mathematics and the Earth & Environmental Sciences. Overall goal of the program is to train a new generation of scientists whose level of mathematical sophistication and understanding of issues in earth and environmental sciences are much higher than students trained in traditional programs. While the proposed research is far from my field, it appears sound and has obvious importance.

What are the broader impacts of the proposed activity?

The educational program appears sound. I like the idea that the students will be required to present their own research at the IGERT Joint Program Colloquium. I also strongly agree with the their intent of ?creating a program that is not unrealistically burdensome? by not adding undue requirements. I found the recruitment and retention of under-represented minorities to be weak, especially in light of departments? track records.

Summary Statement

I declined to rate the proposal because the research is so far from my field.

Reviewer:

Krause, Wendy E.

Email:wkrause@lynntech.com

Suggested Reviewers:
None

Conflict of Interest:
None

Title:IGERT: A Joint Graduate Program in Applied Mathematics and the Earth & Environmental Sciences

Institution: Columbia University

NSF Program: Integrative Graduate Education and Research Training Program, IGERT Full Proposals

Principal Investigator: Polvani, Lorenzo M.

Received Date:04/29/02
Rating: Excellent

Review:

What is the intellectual merit of the proposed activity?

The focus of this IGERT proposal is an integrated graduate program in applied mathematics and Earth and environmental science. This program involves Columbia (five departments -- three math related; two Earth and Environmental Sciences), Lamont-Doherty Earth Observatory, and Barnard College. The P.I.'s have proposed student training in an area that is currently not emphasized in most programs and is sorely needed. Many environmental studies students are trained well in social and political sciences. Training of environmental sciences students can vary widely with respect to their balance of exposure to physical sciences and quantitative methods versus social and political sciences. This program proposes to fill a specific niche by producing Ph.D.'s with strong mathematical and physical science skills and the ability to apply them to environmental research.

Several of the faculty including the P.I. (Polvani) are joint appointments n Applied Mathematics and Earth & Environmental Sciences which should insure good cross-communication. There appears to be a good faculty balance among the primary departments of Applied Mathematics and Earth and Environmental Sciences. Columbia and Lamont-Doherty have a long history of outstanding research in Earth sciences. In recent years, their research in climate change (among other topics) has been at the forefront. The proposed primary research areas -- topics in climate modeling, magma dynamics and geophysics, parameterization of oceanic eddies, Earthquake dynamics, water cycle dynamics -- are of global importance, are computationally intensive, and require integration of data sets of different content and temporal and spatial scales. The program is innovative in its structure by specifically coupling Applied Mathematics and Earth and Environmental Sciences. State-of-the art equipment includes a request for a new computational cluster with parallel processing and the substantial resources and facilities of the existing programs. Significant university resources (stipend supplements, tuition, part of the coordinator's salary, space) are included in the proposal.

What are the broader impacts of the proposed activity?

A very important benefit of this program would be the training of individuals in environmental sciences with strong quantitative and numerical skills. The fundamental research areas that will be addressed within this program (e.g., climate change, Earthquake dynamics, water cycle dynamics) have global significance and societal importance. The program will be managed under the Columbia Earth Institute, which has a global research mandate and a number of associated centers and institutions focused on global research. Solving problems of such complexity requires both fundamental understanding of physical and chemical processes and computational knowledge and skills. A true integration of these areas in a PhD. program would produce well-equipped individuals with the ability to quantitatively tackle a diverse range of problems. If the program can successfully recruit and retain women and minorities, these graduates would be much needed role models in computational sciences.

Summary Statement

Education and Training:
The proposal program will support 12 graduate students per year. Students will be recruited from the five participating departments and receive degrees from these departments. Columbia will augment student stipends, which is important for attracting good students to New York. The current programs are very healthy and should supply an excellent candidate pool. There is a mentoring structure with a primary advisor from the math or Earth science side, a secondary advisor from the other side, and a senior graduate student mentor. This is a particularly nice structure that puts students in contact with a cross section of mentors but does not overwhelm them with too many advisors, and will hopefully engender personal mentoring relationships.

Additional IGERT requirements would be: a new 2-semester course in Applied Mathematics relevant to Earth Sciences; five Earth sciences courses for math students; five math and statistics courses for Earth sciences students; weekly IGERT colloquium and distinguished lecture series; one summer internship at outside lab (academic, government, or industry) (10-12 weeks). There is a required ethics component. There are other provisions for student presentations, faculty-student interaction, and participation in proposal writing and undergraduate mentoring. Most of these appear to be opportunities or suggestions rather than stipulated parts of the program, and some of the requirements are minimal (one presentation per year; one national meeting during the graduate career; one internship). I think it will be important for advisors and the oversight committee to insure that IGERT trainees are taking advantage of the program opportunities beyond these minima. The program does not stipulate other coursework in mathematics or Earth sciences, which I assume will be dictated by the requirements of the home department and the advisor(s). This allows for flexibility, but one worry is that some students may not receive enough appropriate cross-training. For example, can a math-side student take Earth science courses that are essentially computational and never be exposed

to making an actual measurement in the field? I hope that the oversight structure will insure that students are receiving adequate exposure to a breath of topics within the two main disciplines.

The proposal indicates the importance of undergraduate participation in research and the benefits to graduate students in assisting in undergraduate mentoring. I agree strongly with this philosophy; however, it appears that the actual structure and mechanism of this is left to individual research groups, with the potential for abuse or mismanagement. Will there be oversight of graduate-undergraduate mentoring? What will be the role and responsibility of graduate students for undergraduate training?

The strategy for development of diversity and recruitment of underrepresented groups is to couple to existing successful programs involved with undergraduates and high schools (summer research program for minority undergraduates; Institute for Climate and Planets program for teachers and students from New York metro high schools and colleges) and to use the Barnard College Department of Environmental Studies as a conduit. I would encourage the P.I.'s to pay attention to this and to invest considerable effort in recruiting women and minorities into the program at an early stage. It will be important to establish a climate and culture of diversity early on in order to dispel math anxiety and to improve student-student mentoring relationships (I note that there are no women on the faculty from the Columbia side).

The management plan appears sound and consists of a five member steering committee headed by P.I. with four faculty from each participating department; a program coordinator will be hired for day-to-day operations. Outside assessment consists of an advisory panel and evaluation by outside team from the Institute for Learning Technologies (ILT) at Teachers College that will use statistical measures, personal interviews, and focus groups for program evaluation.

Reviewer:

O'Day, Peggy
School of Natural Sciences

Email:poday@ucmerced.edu

Suggested Reviewers:

None

Conflict of Interest:

None

Title:IGERT: A Joint Graduate Program in Applied Mathematics and the Earth & Environmental Sciences

Institution: Columbia University

NSF Program: Integrative Graduate Education and Research Training Program, IGERT Full Proposals

Principal Investigator: Polvani, Lorenzo M.

Received Date:04/26/02
Rating: Good

Review:

What is the intellectual merit of the proposed activity?

The proposal provides a very coherent explanation of the vision and goals, and this research area certainly appears to be ripe for an innovative training program. The major research themes appear to be "at the cutting edge" and quite appropriate for such an effort. Investigators clearly make the case that the research areas will advance knowledge in a variety of fields. In addition, there is an existing institutional base with joint faculty appointments.

The education and training component is weaker, and does not appear to be highly innovative or distinctive. The program needs to show how the "interface" between disciplines is reached, accessed, and experienced by students.
The internship requirement is a promising item, as is the mentoring of undergraduates. It is not apparent where the elements of leadership and teamwork are explicitly included in the training plan. There is the suggestion of one new integrated course (and not much detail on what it would contain), giving presentations, and attending seminars and professional meetings, each of which is fairly standard for a PhD program. The "picking good research problems" element is especially vague, and there is no clear connection between this and the ethics component mentioned near the end. Is the ethics seminar required (it seems like it would be an excellent seminar and should be)? It is not indicated as required in the course listing.

There is a solid plan for recruiting underrepresented groups, as well as a coherent plan for recruitment and retention.

CU has good recent training experiences, but the PIs did not illustrate how they personally have been or might be involved in similar training efforts.

The faculty mentoring aspect of the plan is a nice feature, and there is a well thought out evaluation plan. It is especially important to evaluate the pedagogical aspects of the program.

What are the broader impacts of the proposed activity?

Research areas are linked to important broad areas of knowledge and could be highly significant.

Internships have potential to have broad impacts for both students and host organizations. Broader impacts of the research themes are potentially significant, but not sure that the training and education are going to have that broad of an impact.

Summary Statement

Reviewer:
Ryan, Clare
Management & Engr. Division

Email:cmryan@u.washington.edu

Suggested Reviewers:
None

Conflict of Interest:
None